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(54) **IP ROAMING NUMBER GATEWAY**

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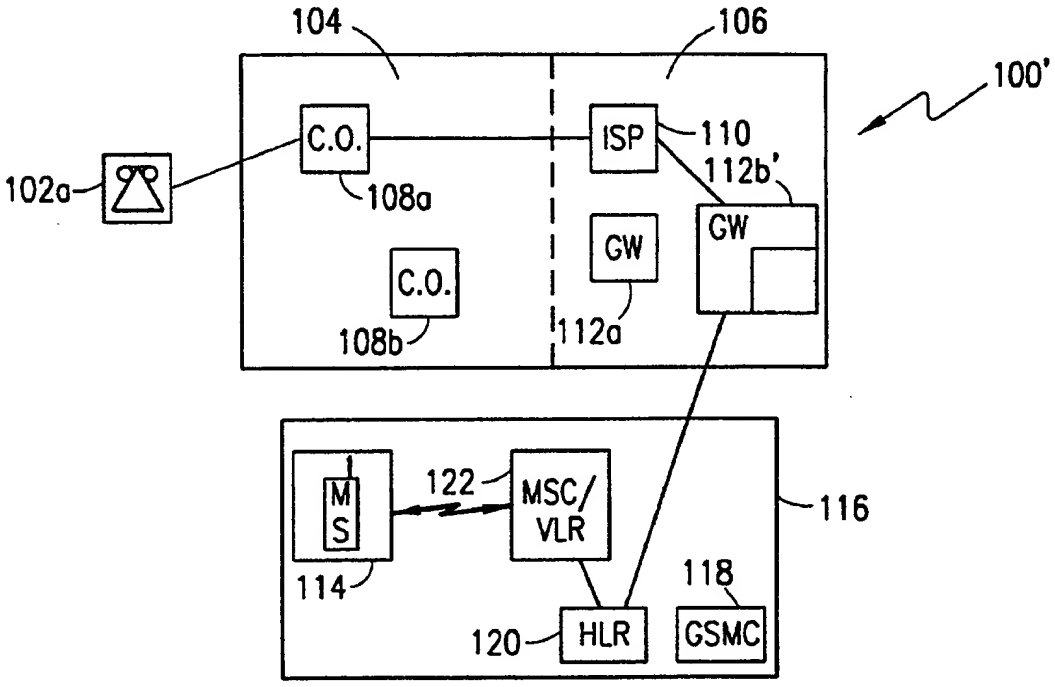
(52) **U.S. Cl.** **455/433**; 455/426

(57) **ABSTRACT**

Methods and arrangements are provided that allow for an Internet gateway to directly request or otherwise access routing and/or location information within a home location register (HLR) within a mobile communications network. This allows for Voice over Internet Protocol (VoIP) communications to be conducted without requiring excessive signaling and/or processing within the mobile communications network. The methods and arrangements can be provided in the form of a standalone node or incorporated into existing nodes, such as, for example, a gateway node within the Internet or a similar network. Verification and/or policing functions are also provided to limit access to the routing and/or location information.



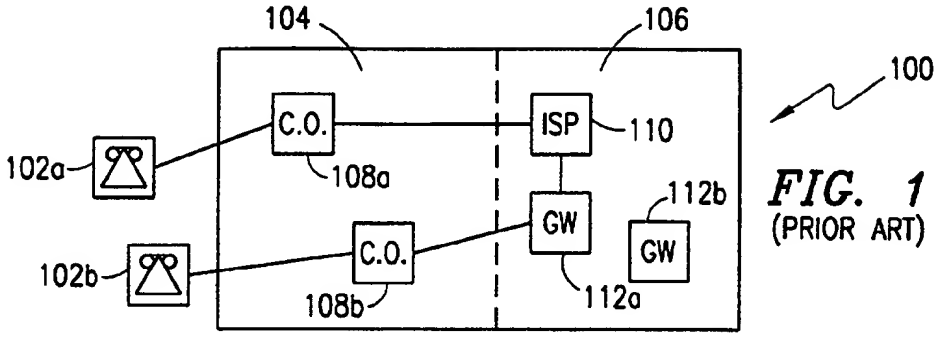


FIG. 1
(PRIOR ART)

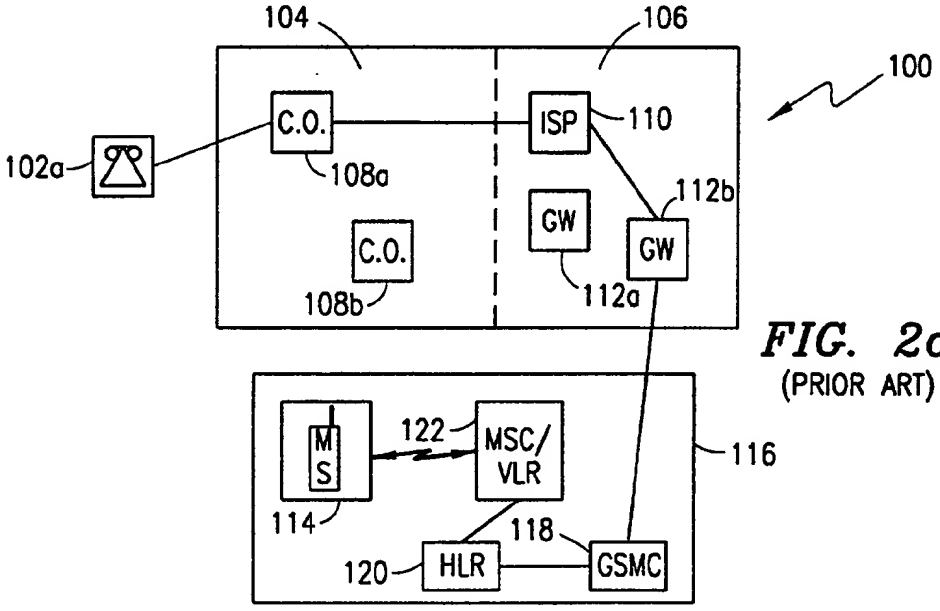


FIG. 2a
(PRIOR ART)

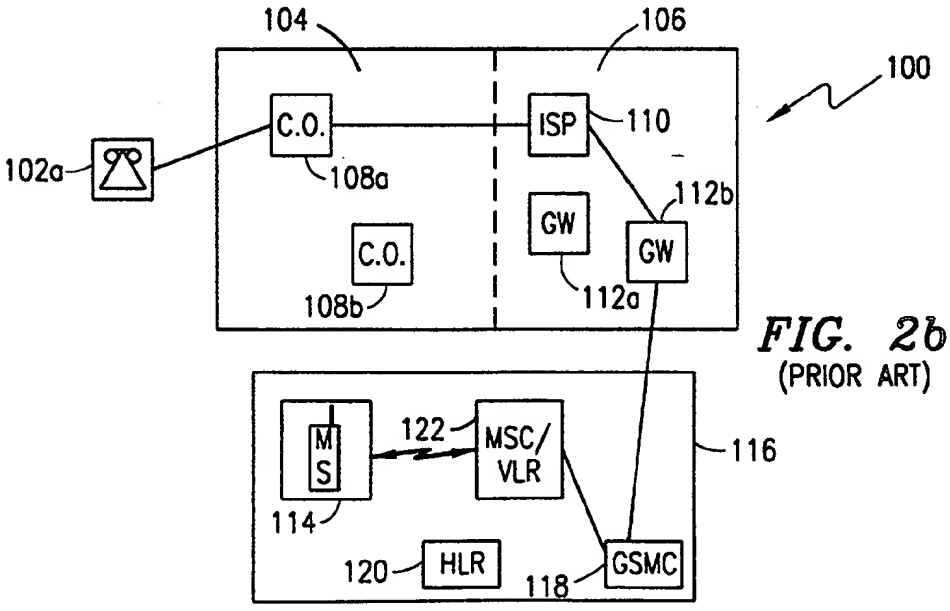


FIG. 2b
(PRIOR ART)

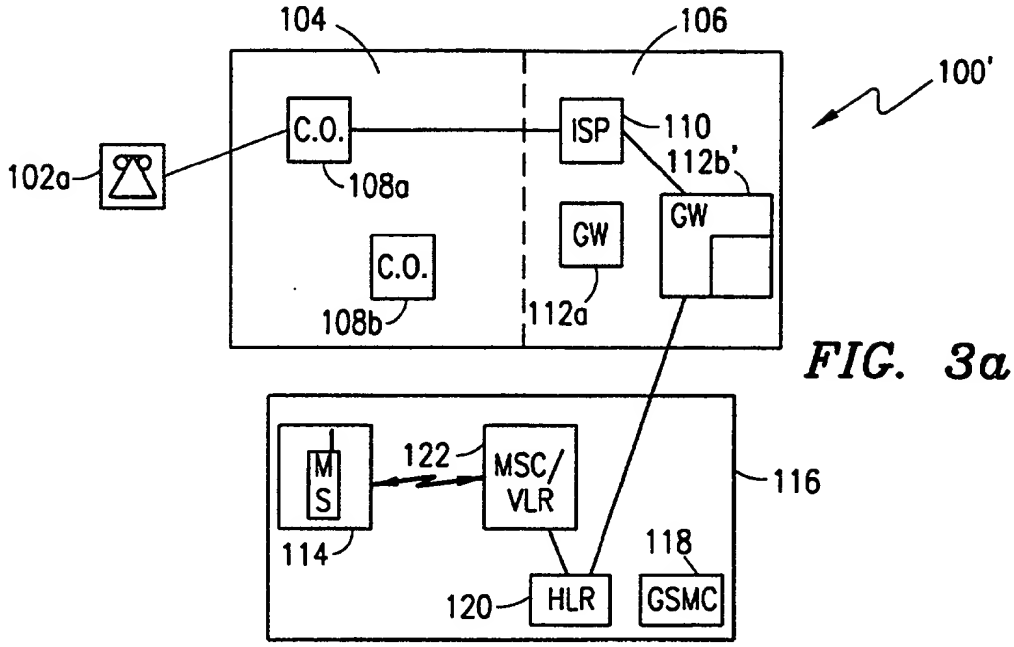

104
106
100'
C.O.
ISP
110
112b'
102a
108a
GW
GW
C.O.
108b
112a
M
S
122
MSC/
VLR
116
114
118
120
HLR
GSMC

FIG. 3a

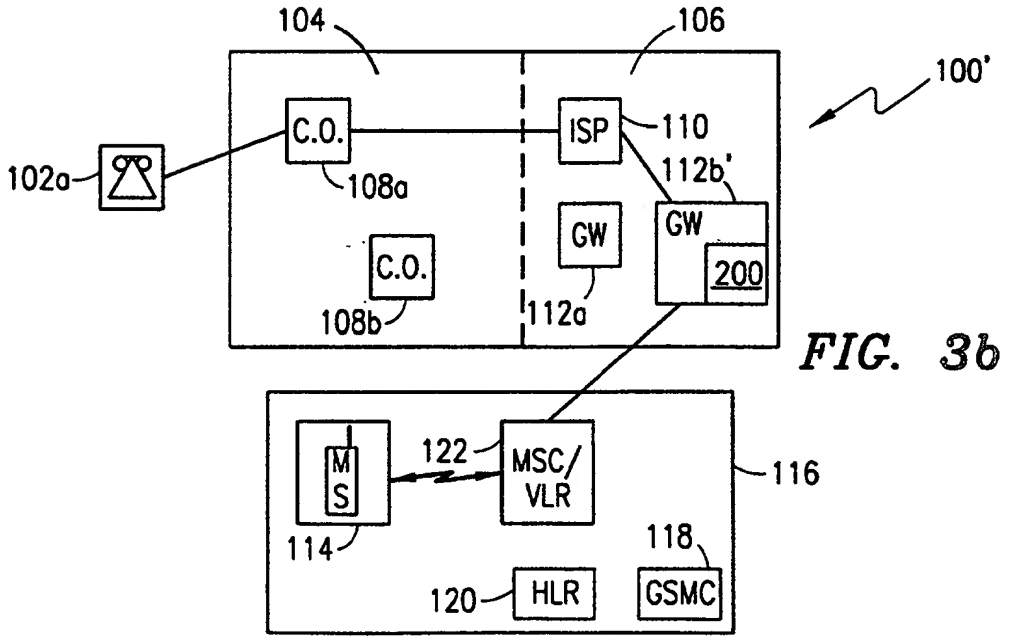

104
106
100'
C.O.
ISP
110
112b'
102a
108a
GW
GW
200
C.O.
108b
112a
M
S
122
MSC/
VLR
116
114
118
120
HLR
GSMC

FIG. 3b

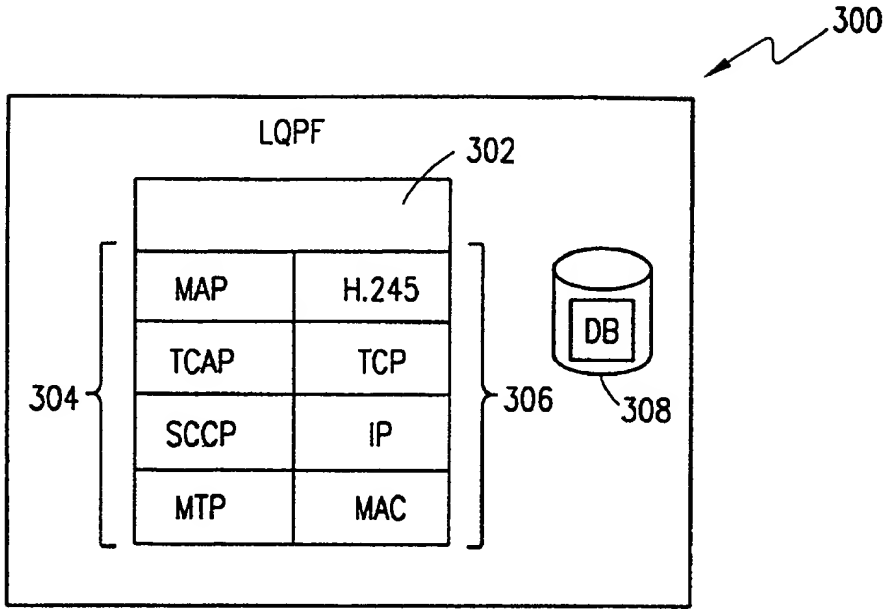

300
LQPF
302
MAP
H.245
TCAP
TCP
SCCP
IP
MTP
MAC
304
306
DB
308

FIG. 4

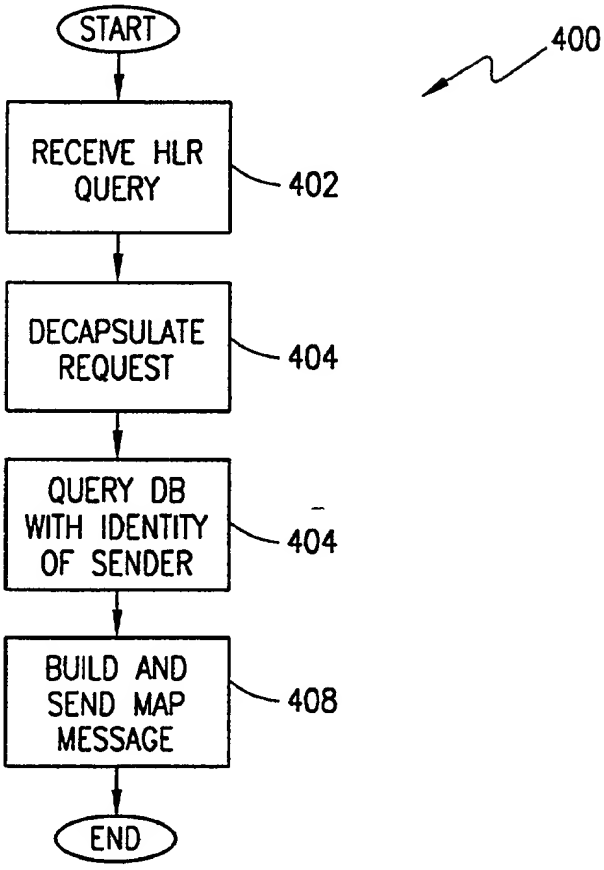

400
START
RECEIVE HLR QUERY
402
DECAPSULATE REQUEST
404
QUERY DB WITH IDENTITY OF SENDER
404
BUILD AND SEND MAP MESSAGE
408
END

FIG. 5

IP ROAMING NUMBER GATEWAY

BACKGROUND OF THE PRESENT INVENTION

[0001] Field of the Invention

[0002] The present invention relates generally to communication systems, and, more particularly, to improved methods and arrangements for interfacing Internet protocol (IP) networks and similar networks to mobile telecommunications networks.

BACKGROUND AND OBJECTS OF THE PRESENT INVENTION

[0003] There is currently a movement towards enhancing the capabilities of computer networks, such as the Internet, to support traditional telephony operations. The goal is to provide quality voice communications over the packetized Internet. This capability is often referred to as voice over IP (VoIP). VoIP, over the current Internet, for example, can provide acceptable voice communications at a greatly reduced cost to the user, when compared to traditional telephone tolls.

[0004] **FIG. 1** is a block diagram depicting an exemplary conventional VoIP call over a communications system **100**. Communications system **100** includes terminals **102***a* and **102***b* that are used by the calling party and called party, respectively. Terminals **102***a-b*, can include, for example, a conventional personal computer (PC) that is configured with hardware/software to support VoIP, or simply a telephone (wired or wireless). As shown, terminals **102***a-b* are each connected to a public switched network **104** and Internet **106**, in this exemplary embodiment. When the calling party places a VoIP call to using terminal **102***a*, a central office **108***a*, or similar switching center, is used to connect terminal **102***a* to an Internet Service Provider (ISP) **110**, or similar gateway/server. From ISP **110**, the call is connected to an appropriate gateway **112***a*, for example, that is configured to connect the call through another central office **108***b*, or similar switching center, to terminal **102***b*. In this manner, the connection through Internet **106** preferably provides a significant long distance connectivity that saves the users money by reducing the associated tolls for the call.

[0005] With this simplified example in mind, **FIGS. 2***a* and **2***b* depict a call to a mobile station **114** within a mobile communications network, such as, for example, a Public Land Mobile Network (PLMN) **116**. Mobile station **114** can be a mobile cellular radio telephone, or similar device, for example. As such, in order to successfully route the call from terminal **102***a* to mobile station **114**, there is a need to determine where mobile station **114** is located within the service area of PLMN **116**.

[0006] Thus, communications system **100** in **FIGS. 2***a* and **2***b* depict exemplary connectivity/functions required to connect terminal **102***a* to mobile station **114**. Referring to **FIG. 2***a*, the call from terminal **102***a* is placed through central office **108***a* to ISP **110**. ISP **110** connects to gateway **112***b*. Gateway **112***b* sends a message over signaling system number 7 (e.g., ISUP) lines to a gateway mobile services switching center (GSMC) **118**. GSMC **118** forwards a Send Routing Information message, or similar query, for example, to a home location register (HLR) **120**. HLR **120** then communicates with one or more combined mobile services switching center/visitor location registers (MSC/VLRs), such as MSC/VLR **122**. MSC/VLR **122** is configured, for example, through at least one base station (not shown) to provided wireless communications to mobile station **114**. Through these connections/functions, the location of mobile station **114** is determined, for example, by having mobile station **114** register with the closest base station and MSC/VLR **122**. Information about the current location of mobile station **114** is then passed back to HLR **120** and from there to GSMC **118**.

[0007] Referring now to **FIG. 2***b*, GSMC **118** then connects the call through MSC/VLR **122** and eventually to mobile station **114**.

[0008] Thus, as can be appreciated, as depicted in the simplified exemplary example in **FIGS. 2***a* and **2***b*, there are significant amounts of signaling, transmission facilities and processing required to support a call from terminal **102***a* to mobile station **114** through Internet **106**. This is because the Internet or other IP network, for example, does not know where mobile station **114** is located and cannot therefore efficiently route the call to the proper MSC/VLR. As such, additional processing is required to handle the call. Thus, there is a need for improved methods and arrangements that significantly reduce the signaling, transmission facilities and processing burdens placed on the PLMN and IP network resources.

SUMMARY OF THE INVENTION

[0009] The present invention is directed towards improved methods and arrangements that significantly reduce the signaling, transmission facilities and processing burdens placed on mobile communications network and IP network resources by allowing a gateway or similar function within the IP network to directly query subscriber information within the mobile communications network to determine the location of the mobile station being called.

[0010] In accordance with certain aspects of the present invention, therefore, the location of a mobile station within a mobile communications network can be determined by one or more applications within, or connected to, the IP network.

[0011] In accordance with certain further aspects of the present invention, the amounts of signaling, transmission facilities and processing required to support VoIP calls in a mobile communications network are reduced.

[0012] In accordance with still other aspects of the present invention, a policing capability is provided for use in an IP network for controlling access to various resources, such as, for example, a location register, within a mobile communications network.

[0013] In accordance with still further aspects of the present invention, the improved methods and arrangements allow for a VoIP packetized call to be carried further within the overall communications system. For example, it is possible to carry the packetized call all the way to a transcoder/rate adaption unit within a MSC/VLR, where the speech traffic is then converted directly to its over-the-air format without an intervening decoding, for example, to a G.711 PCM format. Thus, the IP voice traffic is carried as far as possible, while maintaining the integrity of the supporting Common Channel Signaling network.

[0014] A more complete appreciation of the present invention and the scope thereof can be obtained from the accompanying drawings which are briefly summarized below, the following detailed description of the presently-preferred embodiments of the invention, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A more complete understanding of the method and apparatus of the present invention may be obtained by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

[0016] **FIG. 1** depicts a block diagram of a conventional communications system configured to support voice over Internet protocol (VoIP) calling;

[0017] **FIGS. 2***a* and **2***b* depict block diagrams of a conventional communications system configured to support voice over Internet protocol (VoIP) calling to mobile communications network resources;

[0018] **FIGS. 3***a* and **3***b* depict block diagrams of a n improved communications system having an IP roaming number gateway configured to support voice over Internet protocol (VoIP) calling to mobile communications network resources, in accordance with certain embodiments of the present invention;

[0019] **FIG. 4** is a block diagram depicting a location query and policing function (LQPF) arrangement for use in the IP roaming number gateway of **FIGS. 3***a-b*, in accordance with certain preferred embodiments of the present invention; and

[0020] **FIG. 5** is a flow-chart depicting a portion of a policing process for use in the LQPF of **FIG. 4**, in accordance with certain embodiments of the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

[0021] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0022] **FIG. 3***a*, which is similar to **FIGS. 1 and 2***a-b*, depicts an improved communications system **100'**. As shown, within Internet **106**, or similar network, there is provided an improved gateway **112***b'* having a roaming number application **200** that is configured to allow for direct querying/access to subscriber information (e.g., location information) associated with mobile station **114**. The improved gateway **112***b'* as such, becomes a IP roaming number gateway that is capable of determining where mobile station **114** is located within PLMN **116**, for example. Thus, as depicted, gateway **112***b'* directly queries HLR **120** for the location of mobile station **114**, when a call is placed from terminal **102***a*. HLR **120** provides the requested subscriber location information to gateway **112***b'*. Subsequently, as depicted in **FIG. 3***b*, gateway **112***b'* then routes the call to MSC/VLR **122**. This basic operation, therefore reduces that amount of processing/signaling support required by the various resources in PLMN **116**.

[0023] In accordance with certain preferred embodiments of the present invention, the packetized call is proved directly to MSC/VLR **122** (e.g., to a transcoder/rate adaption unit therein) where the speech traffic is converted directly to its over-the-air format without an intervening decoding process. For example, the packetized call can be converted to G.711 PCM format. In this manner, the IP voice traffic is carried as far as possible in communications system **100'**, rather than being converted at an earlier stage/node.

[0024] Thus, gateway **112***b'* is configured to directly route calls to the MSC/VLR **122** in which the mobile station **114** is currently registered, thereby significantly optimizing the route, when compared to using GMSC **118**. Gateway **112***b'* can be a standalone node, or can be an enhanced gateway or gatekeeper (in the case of H.323 networks) element.

[0025] Providing querying capabilities to applications within or connected to Internet **106**, for example, raises several security concerns. One of these concerns is regulating which of the various applications can request/query or otherwise access the subscriber information within mobile communications network **116**, and in particular, which of the various applications can access HLR **120** for location information directly. Another related concern is the need to monitor and control unintentional and/or intentional misuse of such a query capability.

[0026] Thus, in accordance with certain further embodiments of the present invention, roaming number application **200** not only includes an appropriate request/query interface capability , but also includes a policing function that controls and/or monitors access to the query capabilities.

[0027] By way of example, **FIG. 4** is a block diagram **300** of a layered model of an exemplary location query and policing function (LQPF) within roaming number application **200**, as embodied, for example, in gateway **112***b'*. As depicted the LQPF includes application layer **302**, and protocol stacks **304** and **306**. Protocol stack **304** is used to interface with mobile communications network **116**, and protocol stack **306** is used to interface with Internet **106** (e.g., using H.323 compliant functions). Protocol stacks **304** and **306** are only examples, thus, other protocol stacks can be employed as required for other types of interfaces/configurations. It is preferred, however, that protocol stack **306** includes a reliable transport mechanism. Thus, for example, TCP as opposed to UDP is shown, because of the inherent danger of retries in the event of lost packets.

[0028] Referring to **FIG. 4**, LQPF **300** includes a Mobile Application Part (MAP) interface on the mobile communications network "side" (i.e., stack **304**) and an IP-query interface H.245, for example, on the Internet "side" (i.e., stack **306**). When a request for a roaming number is received on the IP interface side, the request will include a Source Address (e.g., the IP address, or MAC address, of the source entity) that identifies the source application/node. This "source identifier" is used in application **302** to verify that the source application/node is allowed to request subscriber information from HLR **120**.

[0029] Application **302** performs at least two functions in accordance with certain preferred embodiments of the

present invention. The first function is an encapsulate/decapsulate function, which essentially converts the Internet request message (e.g., a H.245 message) into a corresponding mobile communications network message (e.g., a MAP message). During this conversion process, the source identifier is extracted.

[0030] The second function is a policing function in which the source identifier is examined to determine if the source is a trusted source that can query HLR **120**. For example, the source identifier can be compared to an existing trusted database **308** that lists or otherwise defines those applications/nodes that can query HLR **120**.

[0031] The policing function can also be used to further determine if the request for an HLR query is to be processed. For example, the policing function may determine that the HLR or other network resources are too busy to handle such a query, and/or that the source application/node has exceeded a threshold number of such requests over a defined period of time, or otherwise appears to be abusing the system in someway. The policing function, therefore, prevents unintentional or intentional misuse of the HLR query, which could be deleterious to the operation of the mobile communications network **116**.

[0032] For further description, reference is now made to **FIG. 4**, wherein application **302** is configured to provide both decapsulation and encapsulation of the HLR query request message received through stack **306**. Here, decapsulation essentially involves receiving the H.245 request packet, which includes a MSISDN or, more generally, the called party number for the mobile terminal **114**. The packet also contains the identification of the application/node or user making the query request. For example, the packet can include the IP address of terminal **102***a* or ISP **110**, etc. This "source identifier" is then used in the policing function. Here, encapsulation involves building the inputs to the MAP message (for instance Send Routing Information, in a GSM system) for delivery to the lower C7/S7 layers in stack **304**. The MAP message is then passed on to HLR **120**.

[0033] Preferably, encapsulation only takes place after the source identifier has been verified by the policing function, for example, using trusted database **308** or another trusted resource. Thus, encapsulation is only necessary if the policing function within application determines that the query should be allowed to continue.

[0034] **FIG. 5** is a flow-chart depicting an exemplary process **400** for use in application **302**, in accordance with certain embodiments of the present invention. Process **400** includes receiving the request for HLR query in step **402**. In step **404**, process **400** includes decapsulating the request. A policing function is conducted in step **406**, wherein trusted database **308** is accessed to determine if the source identifier is allowed to query HLR **120**. Next, in step **408**, if the various tests within the policing function are satisfied, then an appropriate MAP message is built and sent to HLR **120**. HLR **120** then returns the query with the location of mobile station **114** and the voice information is passed on through to MSC/VLR **122** and eventually transmitted to mobile station **114**, using conventional techniques.

[0035] Although preferred embodiments of the system and method of the present invention have been illustrated in the accompanying drawings and described in the foregoing detailed description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

What is claimed is:

1. An arrangement for use in a communications system having at least one packet switched network and at least one mobile communications network, the arrangement comprising:

at least one mobile station within the mobile communications network;

a resource locator, within the mobile communications network, the resource locator being configured to determine a route for incoming calls to the mobile station; and

an application within the packet switched network that is configured to request information from the resource locator about the route for incoming calls to the mobile station.

2. The arrangement as recited in claim 1, wherein the resource locator determines the route for incoming calls to the mobile station when queried by the application.

3. The arrangement as recited in claim 2, wherein the resource locator is a home location register (HLR) and the arrangement further includes at least one switching center, within the mobile communications network, to which the mobile station is registered, and the information about the route further includes information about the switching center.

4. The arrangement as recited in claim 3, wherein the arrangement further comprises at least one gateway, within the packet switched network, and wherein the application is substantially within the gateway.

5. The arrangement as recited in claim 4, wherein the application further comprises a policing function that determines if a request for the route information is sent from the gateway to the resource locator.

6. The arrangement as recited in claim 5, wherein the policing function is further configured to verify if a source, as identified by the application, is allowed to query the resource locator for the route information.

7. The arrangement as recited in claim 6, wherein the arrangement further comprises at least one trusted database that is configured to be accessed by the policing function in the application to determine if the source is allowed to query the resource locator for the route information.

8. The arrangement as recited in claim 4, wherein the application is further configured to receive a request message through the packet switched network and output a query message to the HLR.

9. The arrangement as recited in claim 8, wherein the request message is a H.245 formatted message received through a TCP/IP protocol stack.

10. The arrangement as recited in claim 8, wherein the query message is a MAP formatted message.

11. An apparatus for use in a communications system having a mobile communications network that includes at least one mobile station and a resource locator determining a route for incoming calls to the mobile station, the apparatus comprising at least one application within a packet switched network that is configured to communicate to the

resource locator within the mobile communications network and thereby request information from the resource locator about the route for incoming calls to the mobile station.

12. The apparatus as recited in claim 11, wherein a request from the application causes the resource locator to determine the route for incoming calls to the mobile station.

13. The apparatus as recited in claim 12, wherein the request from the application causes the resource locator to access a home location register (HLR), within the mobile communications network, that identifies a switching center, also within the mobile communications network, to which the mobile station is registered, and the information about the route further includes information about the switching center.

14. The apparatus as recited in claim 13, wherein the application is substantially within at least one gateway, within the packet switched network.

15. The apparatus as recited in claim 14, wherein the application further comprises a policing function that determines if a request for the route information is sent from the gateway to the resource locator.

16. The apparatus as recited in claim 15, wherein the policing function is further configured to verify if a source, as identified by the application, is allowed to query the resource locator for the route information.

17. The apparatus as recited in claim 16, wherein the apparatus further comprises at least one trusted database that is configured to be accessed by the policing function in the application to determine if the source is allowed to query the resource locator for the route information.

18. The apparatus as recited in claim 14, wherein the application is further configured to receive a request message through the packet switched network and output a query message to the HLR.

19. The apparatus as recited in claim 18, wherein the request message is a H.245 formatted message received through a TCP/IP protocol stack.

20. The apparatus as recited in claim 18, wherein the query message is a MAP formatted message.

21. A method for routing a call from a packet switched network to a mobile communications network, the method comprising:

identifying within the packet switched network that a called party is a mobile subscriber within the mobile communications network;

from within the packet switched network, directly accessing routing information about the called party from within at least one location register within the mobile communications network; and

routing a call to the mobile subscriber through at least one switching center within the mobile communications network as identified in the routing information.

22. The method as recited in claim 21, wherein the step of directly accessing the routing information further comprises verifying that a requesting source be allowed to access the routing information.

23. The method as recited in claim 22, wherein the step of routing the call to the mobile subscriber through the switching center is only conducted if the step of verifying that the requesting source is allowed to access the routing information has been satisfied.

24. The method as recited in claim 23, wherein the routing information includes information about the location of the mobile subscriber within the mobile communications network.

25. The method as recited in claim 24, wherein the step of identifying that the called party is a mobile subscriber within the mobile communications network further comprises decapsulating a request message.

26. The method as recited in claim 25, wherein the step of directly accessing routing information about the called party further comprises encapsulating at least a portion of the request message, as decapsulated.

27. The method as recited in claim 26, wherein the step of routing the call to the mobile subscriber through the switching center further comprises building at least one MAP message.

* * * * *

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(12) **United States Patent**
Shur et al.

(10) **Patent No.: US 6,259,701 B1**
(45) **Date of Patent: Jul. 10, 2001**

(54) **METHOD AND SYSTEM FOR A UNICAST ENDPOINT CLIENT TO ACCESS A MULTICAST INTERNET PROTOCOL (IP) SESSION**

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(73) Assignee: **AT&T Corp.**, New York, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/927,426**

(22) Filed: **Sep. 11, 1997**

(51) **Int. Cl.**[7] **H04L 12/28**; H04J 3/26

(52) **U.S. Cl.** **370/401**; 370/252; 370/432

(58) **Field of Search** 370/252, 253, 370/254, 400, 401, 408, 432, 390, 392; 709/203, 204, 206, 205, 227, 228, 229, 230, 231

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Primary Examiner—Wellington Chin
Assistant Examiner—Steven Nguyen

(57) **ABSTRACT**

Unicast endpoint clients (**110, 111, 115**) on an IP Unicast network (**107, 108**) are provided access to Multicast sessions on an IP Multicast network (**101**) through a Multicast-Unicast gateway server (**120, 121**). The server obtains information about sessions on the Multicast network and makes such information available to a Unicast client on the Unicast network upon request by the client. Upon being presented with a list describing the subject matter of each session, the user at the Unicast client selects the session to which he or she wants to join, which causes the Multicast-Unicast server to join the appropriate session on behalf of the requesting client for each media type in which the joining client wants to be a participant. The server then sets a bidirectional Unicast User Datagram Protocol (UDP) stream between itself and the client. All packets then received by the server from the Unicast client are address-translated to the appropriate Multicast session address. In addition, all packets received by the server on the Multicast session address are address-translated and sent to the Unicast client. The Unicast client is then able to participate in the Multicast session as both a sender and a receiver of packets to and from other Unicast and Multicast clients which are active during the session. Further, the Unicast client is capable of creating a new session, recording a session in the network for later retrieval and playback, and creating and accessing low bandwidth versions of existing sessions.

15 Claims, 7 Drawing Sheets